ADDRESSES

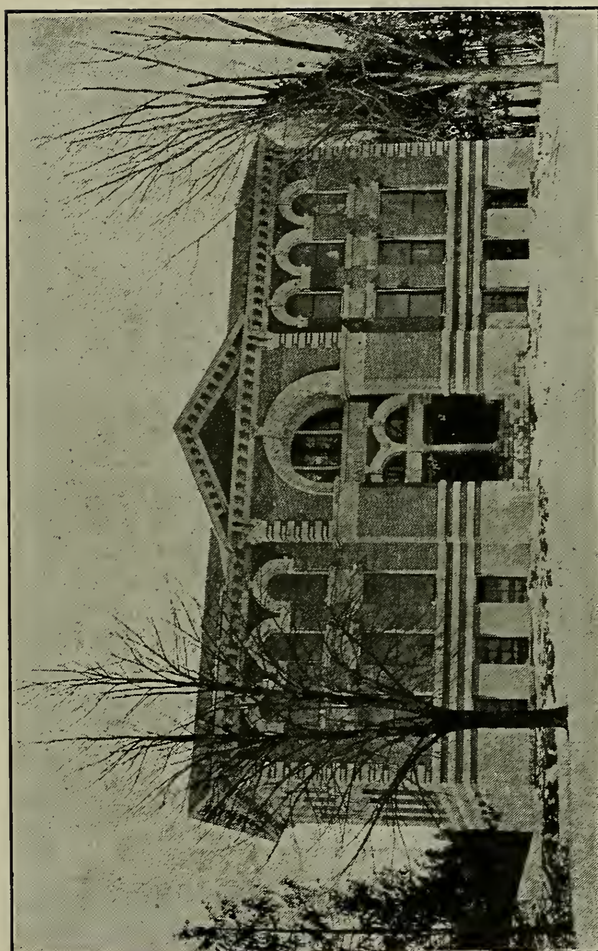
Delivered at the

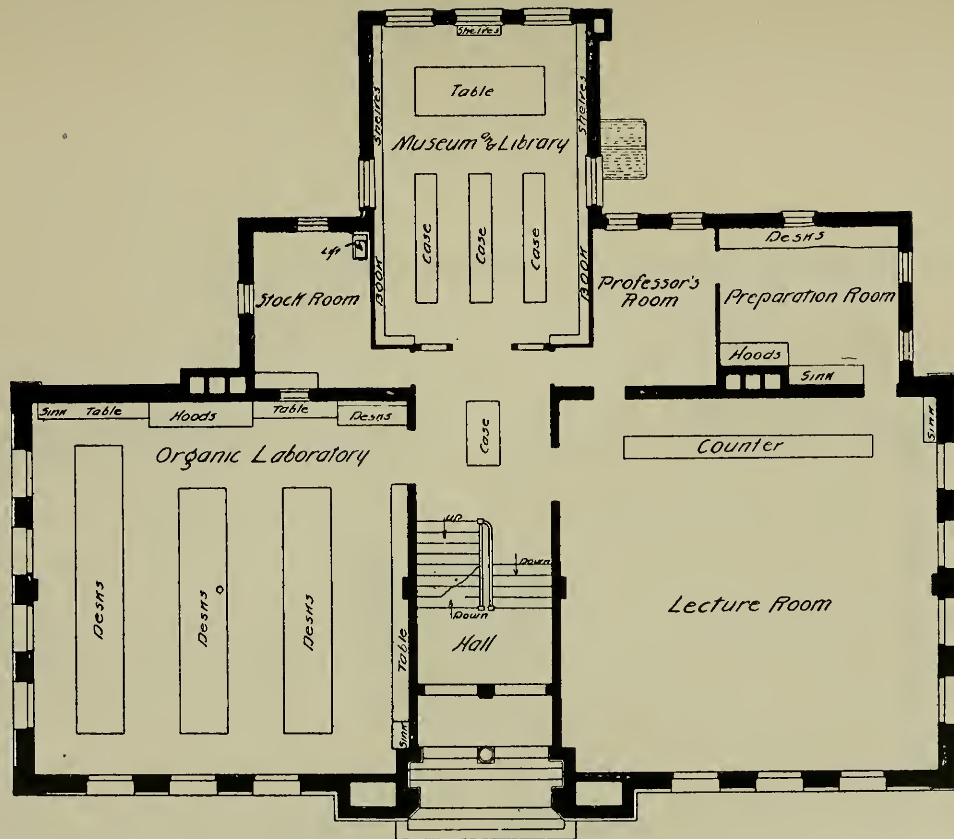
Dedication of Gayley Hall

LAFAYETTE COLLEGE

APRIL 5, 1902

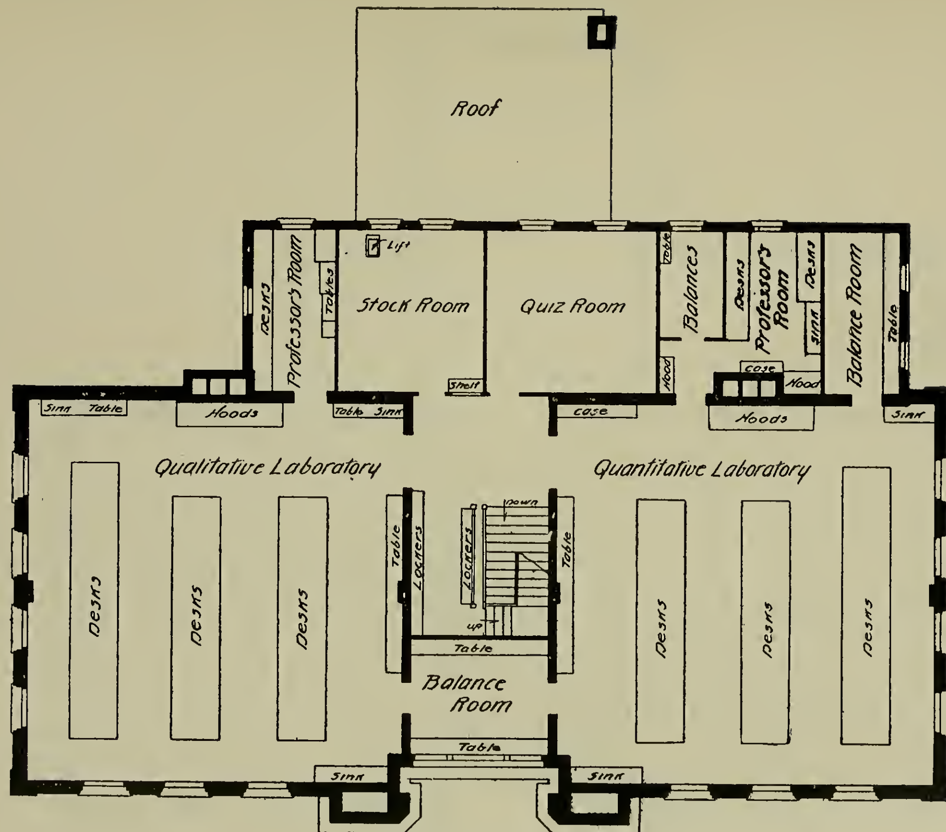
EASTON, PA.
May, 1902.



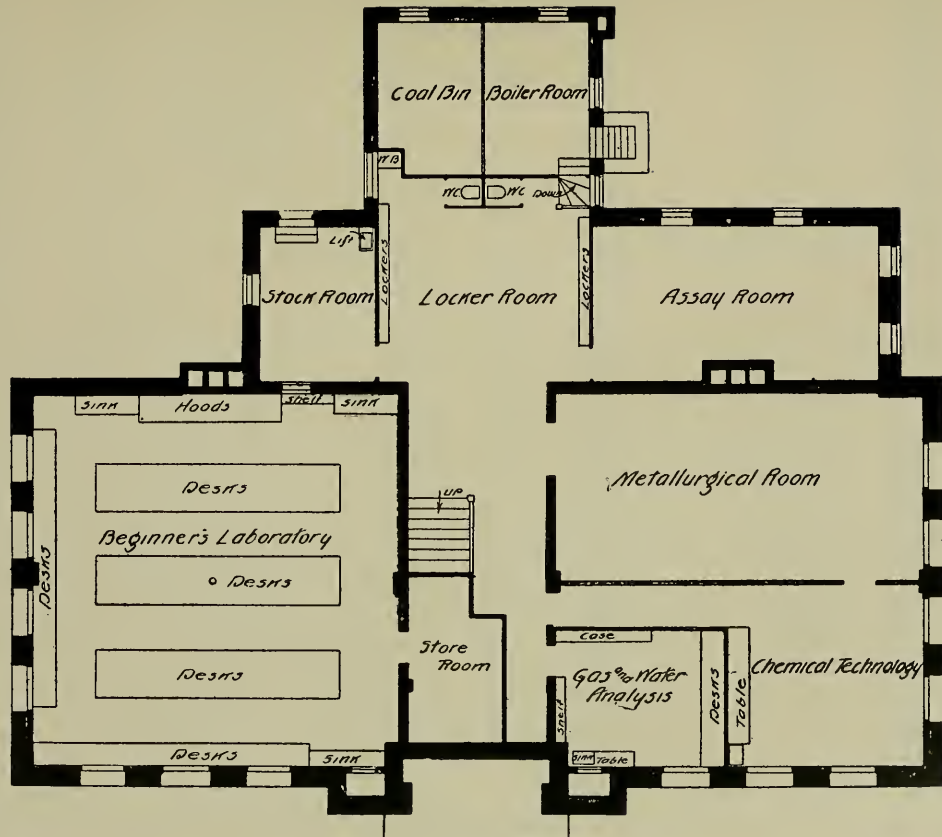


Museum and Library
Table
Shelves
Case
Case
Case
Book
Book
Stock Room
Lift
Professor's Room
Preparation Room
Desks
Hoods
Sink
Counter
Organic Laboratory
Sink
Table
Hoods
Table
Desks
Case
Desks
Desks
Desks
Table
Sink
Up
Down
Down
Hall
Lecture Room

FIRST FLOOR.



SECOND FLOOR.


Coal Bin
Boiler Room
W.B.
W.C.
W.C.
Down
Lift
Stock Room
Lockers
Locker Room
Lockers
Assay Room
Sink
Hoods
Shelf
Sink
Desks
Beginner's Laboratory
Desks
Desks
Desks
Desks
Sink
Up
Store Room
Metallurgical Room
Case
Gas and Water Analysis
Desks
Table
Chemical Technology
Shelf
Sink
Table

BASEMENT.

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DEDICATORY ADDRESSES

GAYLEY HALL, containing the laboratories of chemistry and metallurgy, was built and presented to Lafayette College by James Gayley, of the Class of 1876. Mr. Gayley is now a Trustee of the College, and First Vice-President of the United States Steel Corporation.

The exercises were held in the auditorium of Pardee Hall, in the presence of a large audience of distinguished men of science and letters, educators and business men. President Ethelbert Dudley Warfield presided. Prayer was offered by Rev. M. J. Eckels, of the Class of 1877. Dr. Warfield then introduced Professor Edward Hart, who had been asked to give a brief description of the new building. Professor Hart spoke as follows:

Professor Hart's Address.

My task is to endeavor, on behalf of the Building Committee, to give you some idea of the new building. The Building Committee consisted of Mr. Gayley and myself. Mr. Gayley preferred that the building be, in general appearance, something like those of Columbia College, but, he said to me, "you are to live in it and I wish you to make the arrangement of the inside entirely to suit yourself." The building operations have been in my charge, therefore, and have drawn heavily on my time and patience, so that if you find mistakes they are to be charged to me. I think some mistakes have been made, but none I hope beyond remedy. The laboratory is, first of all, a shop where work is being done and the prime considerations are convenience in a building with plenty of light and air which can be kept clean. To the chemist, cleanliness is of more importance than godliness. So we have tried to build a building which could be kept clean. Those of you who may be disposed to criticize the absence of some of the elaborate arrangements often seen, must remember that college boys are in the effervescent period of their lives and that such arrangements would not, therefore, be appropriate.

The building is of brick, trimmed with Indiana limestone and terra

cotta. The walls have an air space throughout to keep them dry. The floors and roof are supported on steel beams upon which are laid cement floors strengthened with expanded metal. These floors are four inches thick and are calculated to support 150 pounds per square foot. The partitions are also of expanded metal on small I beams covered and filled with plaster. They are only two inches thick, but very strong and stiff. The ceilings are high to give plenty of air, and the windows large to give plenty of light. On either side are three large flues eighteen inches in diameter against which the hoods are placed. There are three six-inch openings into each of these hoods, one from each flue, giving a strong draft and at the same time ventilating the laboratory. With a little care we think this will be sufficient. Without care, in a college laboratory, nothing is sufficient. When bromine is being boiled, or hydrogen sulphide made on the desk, or a solution of sulphurous acid evaporated, nothing but forced draft and wide-open windows will make the rooms inhabitable. The ceilings are plastered with cement which we hope and believe will not peel off, and the walls with cold water paint. This we expect to brush off with wire brushes and renew as often as may be necessary. The steel beams have been covered with the best asphalt varnish we could find. This is believed to be the best protective covering where the metal is exposed, as here, to acid vapors. It can be, as you will see, renewed as often as is necessary. The electric wires are run through the hallways so as to prevent the insulating covering from being eaten off by acids, which gave us much trouble in Jenks Hall.

It has been impossible to complete all the fittings in the time allowed—some of the rooms, such as the assay room, which we hope to fit up equal to and very closely resembling the best in Colorado, the metallurgical room, in which I am sure some of you would have been much interested, and the room for crystallization on the large scale, have nothing but the bare walls. I hope those who are interested in these will visit us again and help me to make them what they should be and what I mean they shall be if life and strength hold out,—the best of their kind in the world. We have at last a chance, thanks to Mr. Gayley's kindness, to show what we can do in chemistry at Lafayette College. Such men as Traill Green, Charles McIntire, T. M. Drown, F. P. Dewey, F. C. Blake, F. H. Daniels, A. B. Clemence, Joseph Torrey, Stuart Croasdale, A. H. Welles, R. E. Divine, R. W. Mahon, E. Schultz, P. W. Shimer and R. K. Meade have made Lafayette College well known among chemists and metallurgists. It will be my task to continue the good work, and endeavor

to draw here others who can extend the confines of our knowledge as they have done and make the new light of science which we are lighting to-day, a power for good in the world. I look forward with joy to the days I am to spend in quiet work in the new building, and it is a pleasure to me to promise increased devotion to chemistry, sometimes a hard mistress, but one whose service I love.

I wish to draw your special attention to the Henry W. Oliver Library, appropriately housed in a room on the first floor. The fitting up of this room has given me a great deal of pleasure. Much more, that here I have had the generous assistance of my old-time students, now friends and business associates, Messrs. John T. Baker and George P. Adamson. It is not given to many college professors to have such students as they were, to share in their success and have their help in work like this. Our college trustees have been generous too. They have shown how much they appreciated Mr. Oliver's gift by making the collection of chemical books belonging to the college (a very respectable one) a part of it. With our share of the general library fund I think we can spend about $350 yearly for new books. This room is so arranged that galleries can be added on either side for the storage of books when this becomes necessary.

And now in conclusion I wish to express our thanks to those who have shown their interest in Mr. Gayley's gift by coming, some of them long distances and at considerable sacrifice, to attend these exercises. I wish to thank Dr. Drown, Mr. Gayley's teacher and mine, and Dr. Remsen, my teacher in organic chemistry and in other things which he did not know he was teaching, and Professor Howe, whose work in metallurgy has made him famous all over the world. These gentlemen are to speak to us and then I know that you will thank them too.

Last of all I must thank Mr. Gayley. It is pleasant to us that one of our own boys should have given this laboratory. It is more of a pleasure that it should have been given by a man so well known by his achievements as a metallurgist. It is not news to most of you that our methods of making iron and steel are being earnestly studied by the rest of the world and that Mr. Gayley has had a prominent place in the great and laborious work which has had this result. It is pleasant to know that he traces even a small part of his success to the things he learned here of Dr. Drown, and that he has determined to pass some of them on to the younger generation. But the pleasantest thing

about this gift has been that it was given without parade of any kind, and generously.

On page 6 of our college catalogue I read that "with all its growth Lafayette College remains in fact and in purpose a college. Its aim is the education of men." We have been fortunate in having had many men among us. We have one with us to-day in the place of honor. Hi name is James Gayley.

Following the closing words the students rose and gave the college cheer for Mr. Gayley. Dr. Warfield declared that he heartily emphasized and accentuated Professor Hart's remarks, and then introduced Ira Remsen, LL.D., President of Johns Hopkins University, who spoke on "The Significance of Chemical Laboratories."

The modern laboratory is the result of a process of evolution. As nearly as can be made out, the order of events was about this. Men have always studied in some way the things round about them. The infant does this; the savage does it. Indeed, every animal does it. An immense amount of information was thus early collected. No doubt the facts observed caused a good deal of thinking such as it was ; and the discovery was made that thought is a valuable aid to work. Then followed a long period in which the best thinkers seem to have held that the great problems of the universe are to be solved by mental processes alone. The old philosophers spent their time in speculating upon these problems and gave to the world many ingenious theories, some of which survive to-day in one form or another. The development of the mind was carried to such an extent that a school of philosophers dealt with subjects entirely beyond the powers of man. One question that was much discussed for centuries is of special interest to chemists. I refer to the question whether matter is infinitely divisible or not. As this illustrates the older methods very well, let us look into it a little more closely.

It is plain that any piece of matter, say a piece of iron, can be broken into smaller pieces. In the process of subdivision we finally reach such small particles that it is extremely difficult to handle them, yet no one, I am sure, can imagine this process of subdivision going on forever in the case of any given particle. We are to-day quite willing to acknowledge that our minds are incompetent to deal with such problems. We know

that they are also incompetent to imagine, either that the space of the universe is unbounded or that it has boundaries.

Clearly, such speculations as those just referred to are not well calculated to throw light upon the nature of the things around us. No doubt the discussions did much to develop the mental powers of man, and thus prepared him to take up problems at hand ; but meanwhile the idea became prevalent that there are two kinds of work, mental and hand work, and that, of these, mental work is of a higher order than hand work. This idea has done much to keep the world back. It was this idea that stood in the way of the only kind of work that could possibly develop our knowledge of nature. So long as men in their efforts to learn more of the universe simply sat down and thought about it, progress was necessarily slow. Many beautiful thoughts were evolved to be sure, but in most cases these thoughts were without foundation, or, at least, they went far beyond the limits justified by the facts.

We are suffering to-day, though much less than formerly, from this tendency to substitute speculation for solid work. Everybody has, or thinks he has, a mind, and thinking is so easy that it is carried to an extreme. Scarcely a day passes without its theory. The result is that the world of ideas is filled with a mass of crude material. To the untrained mind one thought is, in general, as good as another. The prime object of education is to train the mind so that it shall be able to distinguish the sound from the unsound, the true from the false. If it fails in that, no matter how much knowledge the student may have, the education is a failure.

My point thus far has been to show that the method followed by our forefathers was not the laboratory method, that it was in fact the philosophical method. What then led to the adoption of the laboratory method? That is a broad question. In attempting to answer it, we are first brought face to face with a body of men who have long figured in history, and generally in a way not worthy of praise. I refer to the alchemists, the seekers after the philosopher's stone. However disreputable many of the alchemists may have been, however dark and devious the arts they practiced, there is no doubt that they laid the foundations of the scientific laboratory. They were workers with things. What matters now that they were dreamers too? They taught us that it is possible to learn some of the secrets of nature by coming in direct contact with the products of nature; by handling them; by subjecting them to new conditions ; in

short, by experimenting with them ; and that is one of the most valuable lessons the world has ever learned.

Whatever may have been the incentive that kept the alchemists at work, the main thing is that they did work. They did not discover the philosopher's stone, or the elixir of life, but they discovered something of far greater value to mankind—the right way to study the world we live in; and, while they were doing their work, they also discovered a large number of substances, the use of which has been of inestimable service to chemistry ever since, without which we could make no progress in the study of chemical phenomena. I need only mention among the substances discovered by them, muriatic, nitric, and sulphuric acids, ammonia, the alkalies, innumerable important metallic compounds, alcohol, ether, phosphorus. Without these the chemist of to-day would be helpless.

The next important thought that contributed to the development of experimental science was a modification of one of the guiding thoughts of the alchemists. It was this, that the object of chemistry is the study of disease and of the means of combating it.

This idea took strong hold, and the workshops of the apothecaries became the chemical laboratories. A large number of the leading chemists of the last century either were apothecaries, or they had first been trained as such, and afterward gave up the practice of this profession. Among those whose names first come to mind in this connection is Scheele, of Sweden. Scheele was probably the most prolific discoverer chemistry ever had. All his life was spent in the practice of pharmacy. But most of his time he was also engaged in experimenting with chemical substances with the sole object of finding out as much as possible concerning them. He delighted in discovery, and no doubt felt as the greatest discoverers have always felt, that their occupation carries with it its own reward.

Observe the change in principle. The alchemist worked for the philosopher's stone; the medical chemist or the pharmacist worked to find a new remedy ; but Scheele and other true scientific investigators worked for the sake of discovery.

The discoveries of Scheele were made in his apothecary shop amid surroundings that would make an undergraduate student of the present day smile in pity, perhaps laugh in derision. And yet this was only little more than a hundred years ago, for Scheele was born in 1742 and died in 1786. It is an interesting and instructive fact that, while Scheele's work was brilliantly successful in the field of pure science, his work as an apothe-

cary was almost a complete failure, judged by the world's standard. He had harder work to make both ends meet than he had to make chemical discoveries. He lived and died in extreme poverty and in poor health.

It was not an easy thing to study chemistry even as late as the first two decades of the last century. The subject was most inadequately provided for at the universities. It was not regarded as offering a career for young men, and only a few, in exceptional circumstances, attempted to pursue it. Each of the older chemists had his own workshop or laboratory, and it was necessary to gain admittance to one of these in order to learn the methods of chemistry.

Wöhler, who so long made Göttingen a Mecca for American students of chemistry, has told in a most interesting way of his experiences. In 1823, immediately after the completion of his medical studies, he decided to devote himself to chemistry. He was advised to go to Stockholm to study with Berzelius, who was then the leader of the chemical world. Speaking of the laboratory of Berzelius, Wöhler says : "I was then the only one in the laboratory. It consisted of two ordinary rooms fitted up in the simplest possible way. It contained neither furnaces nor hoods ; neither water nor gas service. In one room were two ordinary pine tables. At one of these Berzelius had his place and at the other was mine. There were some cupboards on the walls and in these were the reagents; in the middle of one of the rooms was the mercury trough and the glass-blowing table. In addition there was a wash-place, consisting of an earthenware vessel for holding water. In this there was a stop-cock and beneath it was a trough, where Anna, the tyrannical cook, daily washed the dirty laboratory vessels. In the other room were the balances and a few cupboards with instruments and apparatus. In the adjoining kitchen, where Anna preparad our meals, stood a furnace that was rarely used, and the sand-bath that was always kept hot." This is the description of the laboratory of one, who in his time was doing more to advance chemistry than any one else.

We have now reached a critical period in the history of laboratories. At about the same time that Wöhler started for Stockholm, Liebig, who had tried to study chemistry in the apothecary shop and failed, who had then tried the universities of his native country, Germany, and failed here also to get what he wanted,—Liebig started for Paris. After some disappointments, he finally secured permission to work in the private laboratory of Gay-Lussac, one of the shining lights in France, and indeed

a great man judged by any standard. Here Liebig must have made rapid progress, for in a short time he was appointed professor of chemistry in the University of Giessen, he being at the time just twenty-two years of age. This was in 1824, the year after Wöhler had gone to Stockholm. There was, of course, no laboratory at Giessen, and this was the point to which the enthusiastic young chemist first turned his attention. With difficulty he convinced the authorities that a laboratory is the first condition of success in the teaching of chemistry. A laboratory was provided. I wish I could show you a picture of it. It was a poor affair. In fact, it was an old barn refitted. It had no floor, and apparently the roof was imperfect. Everything that we now look for in a laboratory was lacking except—a most important exception—the enthusiastic leader.

This was the first chemical laboratory provided for students ; and no other laboratory has since exerted anything like its influence, not only in chemistry, but upon the development of natural science in general. One of his most brilliant students, the late Professor Hofmann, speaks thus of this subject: "It was at the small University of Giessen that Liebig organized the first educational laboratory, properly so called, that was ever founded. The foundation of this school forms an epoch in the history of chemical science. It was here that experimental instruction, such as now prevails in our laboratories, received its earliest form and fashion; and, if at the present moment we are proud of the magnificent temples raised to chemical science in all our schools and universities, let it never be forgotten that they all owe their origin to the prototype set up by Liebig. The new school called around the master from all nations, a large number of pupils, the *élite* of the then rising generation of chemists, many of whom are now in their turn distinguished masters of the science, having worthily continued in the path of discovery opened for them in their youth, by Liebig."

Now let us turn for a few minutes to the second division of my theme and try to find some answer to the question : What part have laboratories played, and what part are they playing, in the development of mankind? This is too deep a question to be treated lightly, and I cannot hope to deal with it adequately in the short time remaining. Yet I cannot pass it over without some comment.

In the first place, then, it is obvious to every one who knows anything at all about the subject that the scientific laboratories have added, and are adding, enormously to our knowledge of the world we live in. Imagine for a moment what would happen if the work in scientific labora-

tories should stop. The alternative would be simply talking and writing about what has been done. This could go on, perhaps forever, but it would some time cease to be profitable, and we should eventually return to the condition of things that existed in the time of the old philosophers, and we should starve intellectually, just as surely as we should starve physically if the growth of crops should cease.

But the acquisition of knowledge is not the highest aim of man. Unless this knowledge contributes in some way to his uplifting, it is a luxury—of value to be sure, but not a matter of life and death. This brings us directly to the question: What does scientific discovery, or a knowledge of the material universe, accomplish for the elevation of man? I am well aware that, when this question is asked, the answer generally includes, first a reference to the many useful practical applications of the results of scientific discovery such as the steam-engine, the telegraph, electric lights, etc., etc., and to the improvements in the sanitary conditions, and the advances in medicine. These are all, no doubt, of great value, and are directly connected with scientific research. Scientific men welcome every application of the results of their work, and they know that these results are far-reaching and of great value, but with these applications they are not generally directly concerned. It is the province of science to investigate, to discover, to know, to furnish the material or the knowledge that is to be applied, but it is not its province to apply. The invention of the steam-engine was not a scientific achievement any more than was the invention of the telegraph. These, I repeat, are applications of the results of the discovery of certain facts and principles by scientific investigators. To take a recent illustration of this distinction, wireless telegraphy is the practical application of a scientific discovery made a number of years ago by Herz. What Marconi has done is to show that the electric waves discovered by Herz can be utilized for the purpose of transmitting signals for some distance without wires. It is no discredit to Marconi to say that he could not have done his work if Herz had not shown the existence of the electrical waves, but it is of importance to recognize the fact.

This takes me back for a moment to a remark I made some time ago to the effect that Scheele and other true investigators worked for the sake of discovery. I add now that it is the growth of the scientific spirit, in this sense, that is responsible for the great results that have come from the scientific work carried on during the last century. It is only when the investigator is free to work without being asked, or asking

himself, the question : Of what use is this particular piece of work likely to be?—that he is likely to reach the best results. Nearly all, perhaps all, discoveries that have found valuable practical applications have appeared at first to have no practical value, and, if, in each case, the investigator had stopped his work because he could see no use for his discovery, only a very small part of the work that has been done would ever have been completed. So that, if we regard scientific investigation of value only in so far as its results are capable of practical application, we should still have to encourage even that which appears most abstruse and farthest removed from connection with our daily lives.

"The Contributions of Chemistry to Sanitary Science" was the theme of the next address, delivered by Dr. Thomas Messinger Drown, President of Lehigh University.

This happy day for Lafayette College, when its new hall of science is dedicated to the search for truth and to its dissemination, is also one to me of distinct personal gratification. During the years that I had charge of the chemical department here there were many students whose promise of a brilliant and useful life has since been abundantly realized. Among them was the distinguished captain of industry whom we honor and congratulate to-day for his beautiful and pious tribute of love and loyalty to his Alma Mater. And it is also a source of satisfaction for me to contemplate the fact that of this department, now so highly esteemed among men of science and among educators, and destined to become still more favorably known by reason of its increased facilities, its head and one member of its staff were also my students, whose first steps in the science of chemistry it was my privilege to guide. The teacher, I well know, is only too apt to overrate the value of his teaching and of his influence, yet I think his pride in the success and usefulness of his pupils may be generously pardoned.

To cure disease is a noble application of human knowledge and sympathy, but to prevent disease is a still higher service to mankind. The scientific study of morbid conditions involves necessarily the investigation of their causes, and these causes, once determined, we are able intelligently to try to remove them. Thus curative medicine has always preceded preventative medicine, and sanitary science and hygiene are the ripe fruits of the investigations of the myriad forms of disease to which mankind is subject.

Diseased conditions of the body are of two kinds. First, the functional and organic derangements due to abnormal living. When the organs and vital processes are subjected to strains which they are not able or not adapted to bear, the result is that some part or some process breaks down. The enjoyment in an individual of permanent good health based on correct habits of living—habits adapted to the life and the environment—it may be said, in passing, seems sufficiently exceptional to call for comment and congratulation. But there are other diseases against which healthy habits may afford no protection; for they invade our bodies from without through the air we breathe, the food we eat and the articles we handle. These zymotic or germ diseases, a very few years ago thought to be "mysterious dispensations of Providence," are now revealing a proximate cause to patient, scientific investigators.

It is the object of this brief paper to chronicle some of the things that chemistry has done to promote healthy living by throwing light on the nature of normal nutrition in the human system, by pointing out sources of danger, and by preventing the spread of germ diseases.

At the outset it may perhaps be claimed that the new science of bacteriology has taken from chemistry the laurels she once wore, since many of the processes which we were once accustomed to regard as entirely chemical in origin are now known to require life action. The rusting of iron is still admitted to be a purely chemical action, but the oxidation or decay of organic matter we have recently learned cannot go on without the presence of bacteria and the force they supply. In the decay of organic matter the changes are recognized, it is true, only by chemical means, yet the breaking down of organic matter, it is now fully recognized, requires life action as well as building up.

The discovery of the bacteria and the revelation of their functions in nature, has been the crowning glory of scientific research in the century just past, and the successful fighting of a specific disease with the bacterium which caused it is one of the brilliant and beneficent results of this research.

But though chemistry may have to take the second place in the treatment of germ diseases, it still holds the first place in their prevention. Among the myriad forms of bacterial life which break down organic matter and reduce it ultimately to mineral matter that the cycle of nature may go on in its ceaseless round, there are a few whose action or products are distinctly harmful to man, and to destroy these foes of mankind or make them inoperàtive is the province of preventative medicine. It is a

battle royal between the chemical poison, and the poison of the bacteria. Notwithstanding the marvelous rapidity of bacterial growth with a correspondingly profuse elaboration of their distinctive products, the organisms themselves are very susceptible to many chemical agents, some of which, even in infinitesimally dilute solutions, have the power to destroy bacterial life. It is on these chemical germicides that the whole scheme of disinfection is based, whereby we seek to prevent the transmission of specific diseases by killing the germs which produce them.

It would not be possible within the limit of time allotted to this paper, to enumerate all the chemical substances which have had germicidal powers claimed for them or even to enumerate those which have been tested by competent experimenters. Almost daily new ones are added to the list, showing how very wide a range of chemical compounds exert an inhibitory influence on bacterial life.

It must be said in this connection that the statements of investigators in this field are often much at variance with regard to the efficiency of certain germicides. This may indicate that certain bacteria are more resistant to chemical agents than others, and that an efficient germicide in one case may be an imperfect one in another. Further, some bacteria form spores, which, like the seeds of plants, are much more resistant than the cells, and many germicides which destroy the cell structure in a few minutes have no effect whatever on the spores. A thoroughly efficient and universal germicide is one, therefore, which can be relied on to destroy the total vitality of the germ, the spores, as well as the organism itself.

Again, it is absolutely necessary in disinfection that the germicide should be in intimate contact with the material to be disinfected. To put a saucer of chloride of lime, or chloride of zinc, on the floor of a sick room and expect the germs on the walls and ceilings and curtains to be influenced by these chemicals, is to liken their operation to a charm. There are, it is true, gaseous germicides, and their efficiency depends on the thoroughness with which the gases are made to penetrate into all the nooks and corners of a room and to permeate all tissues and fabrics. Efficient disinfection depends on intelligence and thoroughness; half-way measures are valueless.

We use the words disinfectants and germicides interchangeably; to disinfect is to destroy the cause of infection, namely the germs. Confusion often results from the improper use of the word antiseptics in the same sense. An antiseptic is a substance which renders organic matter unfa-

vorable ground for bacterial growth, but it does not necessarily kill the bacteria. In this category are salt, sugar, vinegar and alcohol and other food preservatives. It is obvious that all germicides are antiseptics, but there are many antiseptics that have no germicidal properties whatever. In practice, many of the feeble germicides, or even the powerful germicides in very dilute solution, are used as antiseptics in the dressing of wounds and the preserving of food.

I shall attempt only a brief mention of the substances in general use as germicides. Some of them are inorganic in their origin, some organic, some can be used in the gaseous form in fumigation and others only in solution or admixture with water or other liquid. Thorough contact, as has already been said, is, in any case, the essential condition of success in disinfection.

Corrosive sublimate stands easily first among the inorganic germicides destroying the most resistant bacteria in the dilution of 1 to 1000 or even 1 to 5000 of the salt in water, and in the dilution of 1 to 500 it will destroy spores.

Copper, zinc and other metallic salts in solution have also germicidal properties, but they must be used in rather concentrated solutions to be effective.

Chloride of lime, or bleaching-powder, has long been known as a disinfectant and is most efficacious if intelligently used. A 1 per cent. solution of the powder which still retains 25 per cent. to 30 per cent. of available chlorine destroys cholera and typhoid germs in ten minutes if brought in actual contact with them. It is the calcium hypochlorite in the bleaching-powder which is the efficient agent of disinfection, and the solution of the corresponding sodium compound, sold under the name of Labarraque's fluid, is also a much-used and convenient form of employing a hypochlorite.

The use of quicklime as a disinfectant, in the form of milk of lime, dates from a remote past, and has been justified by recent investigation; but it must be reasonably concentrated. We all associate cleanliness with the odor of fresh whitewash which effectually destroys the musty odor of dark, damp rooms.

Permanganate of potash, contrary to the general notion, has very feeble germicidal properties, though it is one of the best deodorants. Of the latter—the deodorants—there are many efficient substances, such as charcoal and dry earth, but no inference of any specific action on bacteria can be made from this property of removing odor. Still less can

this action be inferred from strong smelling substances which mask the objectionable odor. An old definition of a disinfectant was, as you will remember, a substance which smelt so bad that the windows had to be opened to let in the fresh air, and the latter it was which purified the room.

The mineral acids are also good disinfectants as are also the caustic alkalies, but they are not usually as safe to handle, and to apply, as the dilute solutions of corrosive sublimate or chloride of lime.

Of the inorganic gaseous germicides chlorine and bromine are efficient, but highly objectionable for general use, owing to their corrosive nature. Burning sulphur comes down to us from the ancients, and still holds a place among the approved gaseous disinfectants. Ozone is theoretically an ideal substance for fumigation and it has actually been used as a gaseous disinfectant. But we know as yet too little of its action and of the conditions of its favorable application to assert with positiveness anything definite of its value.

Passing to the organic realm, we find many germicides of the highest value and importance. Prominent among these are the various compounds derived from the tar which results from the destructive distillation of coal and wood. Tar has an ancient reputation for its healing properties and you will recall that Bishop Berkely as long ago as the middle of the 18th Century sang the praises of tar water as a relief or cure for all human ills. Two books are the result of his experience with this remedy: "Siris, a Chain of Philosophical Reflections and Inquiries Concerning the Virtues of Tar Water," and "Further Thoughts on Tar Water."

Among the countless derivatives of the distillation of tar there are very many which possess strongly marked germicidal properties. Phenol, or carbolic acid, is the best known and most widely used, but the cresols, closely related compounds, are much more efficacious. None of them destroy the spores promptly, but the cresols are more satisfactory in this regard than phenol. Naphthol may also be included in this group, although probably less potent than the others.

The host of proprietary and commercial disinfectants have generally metallic chlorides or coal-tar products as their basis, often in a crude and inexpensive form; but unless their exact composition is known, it would scarcely be safe to rely on the manufacturers' statements as to general usefulness.

But the most valuable and remarkable of all the germicides of organic origin has an entirely different source from this benzene group.

Formic aldehyde is now universally recognized as the most generally useful and powerful of all the germicides. It has the advantage that it can be used both in solution, and as a gas, and that though somewhat irritating to the mucous membranes, it is not poisonous and does not injure fabrics or clothes. In a dilution of 1 to 50,000 parts of water it has decided antiseptic action, in a dilution of 1 to 5,000 it kills all germs, and in a somewhat higher concentration it destroys completely the vitality of the spore-forming bacteria.

Of the many hundreds, perhaps thousands, of chemical compounds whose germicidal properties have been investigated by bacteriologists, I have mentioned only those most generally used. Provided with formic aldehyde, corrosive sublimate, chloride of lime, caustic lime and carbolic acid or the cresols we are well equipped to wage successful warfare on the bacteria which are responsible for so much human misery and death.

I must not fail to mention, before leaving the subject of disinfection, that if the conditions favorable for the propagation of bacteria are avoided, the use of chemical germicides may often be unnecessary. Cleanliness is the great agent inimical to bacteria, for their natural habitat is in darkness and dirt, and their unrelenting enemies, sunlight and soap.

I pass now to the antiseptics, substances which have the property of preventing the growth of bacteria although they may not have the power to kill them. In olden days certain substances were spoken of as having healing properties; to-day we call these substances antiseptics. It is antisepsis, in connection with anesthesia, which has robbed surgery of its terrors and made possible operations on the human body which would formerly have been fatal.

But it is of the use of antiseptics in the preservation of food that I wish particularly to speak. The older preservatives, salt, saltpeter, and the gaseous products of the imperfect combustion of wood, giving us salted and smoked fish and meat, have come down from remote ages ; they are still efficient and satisfactory. The recent investigations in bacteriology, however, have shown that there are other substances which act as preservatives and which are easily applied and very efficacious in very small quantities. These modern antiseptics are mainly boric, salicylic and benzoic acids and their alkaline salts. And some of the well-known germicides are also used in very dilute solutions as food preservatives, notably formic aldehyde and sulphurous acid and the sulphites.

There are those who would question whether in offering these sub-

stances to preserve food, chemistry has conferred a benefit on mankind or has inflicted an injury. The untrained and untutored sanitarian — and there are, alas, too many of this kind — is usually pessimistic and dogmatic. He rejoices gloomily over the number and variety of dangers to which mankind is exposed in his food and drink, and apparently welcomes unwillingly the means proposed to obviate them. He argues, with regard to antiseptics, that a substance which is injurious to the human system in large quantity must needs be proportionately injurious in small quantity and further, that as antiseptics preserve food from decay they must necessarily retard or prevent the digestion of food in the stomach. And he even goes so far as to discard argument altogether and cry that the food is "embalmed," as if this term would not equally apply to all preserved food.

Suffice it to say in this connection that it is quite within the province of the physiological chemist to determine whether any of these modern preservatives are injurious to health, either by interfering with digestion or by a process of slow poisoning. Until such determinations are satisfactorily made, caution may well be observed without the wholesale denunciation of these antiseptics as poisons and adulterants. Much has indeed already been done in this direction, and the danger to health from some of these antiseptics has been found to be greatly exaggerated or unfounded, when they are used rationally and intelligently.

But the public who buy preserved foods and are at a loss to know what to believe, have a right to know what they are buying. Prejudices are often as dear to us as principles and they are entitled to a certain measure of consideration. It is very questionable in my mind whether in the present state of our knowledge with regard to preservatives it would be right, absolutely, to prohibit by law the use of the above-mentioned chemicals, but there cannot be any doubt of the need of legislation to compel manufacturers to print distinctly on every package of preserved food a complete list of all the substances entering into its composition, together with the statement of the amount of any preservative which may have been used. The preservation of food for human consumption is a matter of the highest economic and sanitary importance, and any new process of which this preservation is more thoroughly and cheaply effected is a gain to the community, provided it is accomplished without injury to the character and digestibility of the food or without harmful effects on the system.

Before leaving this subject it may be fairly said that there is an objec-

tion to the use of preservatives in some cases which is quite independent of their possible injurious effects, namely, that their use may lead to a lack of cleanliness. This is particularly the case with milk, which can readily be delivered to the consumer in cities with no other preservative than cold, and the temptation to neglect the proper precautions for its collection and preservation, when a few drops of formic aldehyde solution will overcome this neglect, is one which had better not be put in the average milkman's way.

In his analysis of foods and water the chemist has long been considered a safeguard against dangerous impurities, and his authority in this sphere of sanitary science has been undisputed. We may well give him full credit for the accuracy of his determinations, but their bearing on healthy living is not always apparent. Food analyses are mainly directed against adulteration, and while adulteration is generally fraudulent in intent it may not be injurious. In the substitution of corn flour or of glucose for cane-sugar it is the consumer's pocket that suffers, not necessarily his nutrition. In the present general outcry against food adulteration it must be kept in mind that in the great food staples, such as meat and grains, harmful additions or substitutions are very rare. The great field for fraud in food products is in spices, jellies, syrups, and the like. I am not trying to minimize the importance of the chemist's work in this regard ; I am here rather to recount his achievements, among which it may be placed to his credit that he stands as a bulwark against the commercial greed which tampers with the public's food.

In the province of water examination the chemist's verdict on the quality of a water was once considered final, but recent researches in this department of chemistry and sanitation have shown that many of his decisions have condemned good waters and recommended bad ones, simply because the knowledge of the day was inadequate for such decisions. Here again, it was the ignorance of the existence and functions of bacteria, which led the chemist to think that it was the organic matter in water — as harmless often as the vegetables we eat—which was the cause of disease. The old standards of purity of water, which date from this period, have now been entirely superceded by the application of principles based on engineering, bacteriological and chemical facts.

The complete sanitary analysis of a water includes a large number of determinations which have little or no significance in themselves, but which must be interpreted by their relation to one another, and by a knowledge of the water-shed from which the water is obtained. That

this knowledge of the origin of the water is often concealed from the chemist, in order that his opinion shall be unbiased, shows how completely the character and the purpose of a water analysis may be misunderstood. An analysis made under these conditions is usually worthless. Let me take but one illustration to show the necessity of knowing where the water comes from when it is analyzed to determine its fitness for drinking. A characteristic ingredient of waters which have received sewage, or the wastes of human life, is common salt — or chlorine as it is usually expressed in the analysis. But all natural, unpolluted waters contain some chlorine, and those near the sea a very large amount. The determination of chlorine in a sample of water, therefore, has no significance unless the "normal" chlorine of the region is known, for it is only the excess of chlorine over the normal that it is important to know. This normal chlorine has been determined with great thoroughness for the entire State of Massachusetts, under the direction of its State Board of Health, and also for the State of Connecticut. And it is clearly the duty of the boards of health of all states to make this determination for all sections of the state as a basis for the investigations of its natural waters.

It is true that chemistry can never reveal the real cause of danger in a sewage-polluted water, which is always the disease germ present in the sewage, but it can detect the presence of sewage more easily and more quickly than the bacteriologist can detect the presence of the typhoid or cholera germ. But, after all, it is the chemist working hand in hand with the engineer and the biologist which brings out all the facts we are seeking, and it is profitless to try to assign to any of these workers the credit which is properly due him. The selfish spirit which occupies itself mainly in claiming credit for discoveries is unfortunately, not unknown in the scientific world—the spirit which would make the eye say to the hand I have no need of thee and again the head to the feet I have no need of you ; for if one member be honored all the members rejoice with it.

There remains to be mentioned another important contribution which chemistry is making to our knowledge of healthy living, namely, the determination of food values. We now know the rôle which the different elements play in the human economy in the form in which they exist in foods. The physiological chemist distinguishes between the nitrogen and carbon which he finds in meats and grains, and which are promptly assimilated, and the carbon and nitrogen in urea which repre-

sents the waste of the body. The literature on dietaries — the result of investigations of a great variety of foods, to learn their adaptability to persons of different ages, sex and occupations — is now very extensive and of the highest value from a hygienic standpoint. Good health is largely a matter of the proper selection of food, and of its preparation. The chemist tells us, for instance that, as regards available nitrogen, lean beef and dried peas are of equal value, and that to get the same amount of nitrogen as in beef and peas we must consume of oatmeal or eggs one and a half times as much, and of potatoes seventeen times as much, while of skim-milk cheese one-half as much will suffice.

The experiments which have been made in Germany and by Professor Atwater and others in this country, correlating food with heat and energy are of the greatest scientific and practical interest. The knowledge thus gained has been widely disseminated in the community. Food advertisements reflect the popular interest in the subject, and the discussion of starch, fatty and nitrogenous foods has become our table talk.

And yet it must be confessed that though we strive to feed our domestic animals, which we use for power and for food, on strictly scientific principles, there is a reaction against applying these principles to our own dietaries, if our tastes and prejudices are interfered with. Humanity has, it seems, not yet advanced far enough in regarding the body simply as the abode of the spirit to consent to replace an appetizing meal by a menu which merely provides for replacing the waste of the body in carbon, nitrogen and lime. And yet it is not impossible to combine the two. Scientific feeding demands that the food shall be attractive in appearance and taste; it is only against food unfit in quality and quantity that it protests.

Chemistry also points the way to the use of cheaper foods of high nutritive value. But here again the average man rebels, estimating the value of food by its cost. Conservatism, habit and prejudice are hard to overcome in any sphere of life, but in none is the difficulty so great as in that which relates to food, and the physiological chemist will, I fear, have to wait still for many generations before he sees the fruit of his labor to show a more excellent way in the science of nutrition.

In recounting the achievements of the past, there is always a temptation, which it is well to resist, to indulge in prophecies for the future. And yet it is but natural that we should project into the future the curve which represents the contributions which the chemist has already made in sanitary science. And in so doing we have a confirmation of

our faith in the evolution of the human race — physically, intellectually, and spiritually — towards a perfect manhood. This faith receives support, too, in our daily observation that the laws of nature in so many different directions are being revealed to the patient and devout men of science, seeking to discover the hidden mysteries of the universe.

May the hall we dedicate to-day be richly endowed with this spirit of research, and contribute abundantly to the overthrow of darkness and ignorance, and the dissemination of light and truth.

Following Dr. Drown, Dr. Warfield introduced Prof. Henry Marion Howe, of Columbia University, who spoke on "Metallurgical Laboratories."

To an old friend and admirer of the great captain, whose munificence we celebrate to-day, it is a most rare pleasure to have this privilege of adding a word of enthusiastic praise. Let us congratulate Lafayette on this princely gift, and still more on the princely heart that prompted the princely gift. It is a pleasure to watch the growth and success of one whom we esteem; a very great pleasure to see the responsibility of that wealth, which so often intoxicates where it should sober, so soberly and so wisely borne.

The metallurgical laboratory as an instrument for teaching metallurgy is so new a thing, so few of these laboratories have been in long use, and their methods, aims and merits have been so little discussed that not only the thoughtful part of the public, not only educators in general, but even a very large fraction of our metallurgical educators themselves, have but hazy notions about them. Indeed, there are many whose opinions cannot be ignored, many eminent metallurgical educators, who still doubt, or even deny the value of the metallurgical laboratory. Under these conditions it seems well that those of us who are confident that these laboratories are invaluable instruments, should seize occasions like this to give the reasons for the faith that is in them, to the end that, if we are right, our allies, our sister schools here and abroad, may arm themselves with this potent weapon; and that, if we are wrong, we may discover our error through thus uncovering our reasons.

The objections urged against metallurgical laboratory instructions, so far as I understand them, are two:

First, metallurgy, like every other profession, has its art, and also its science, that is to say, the systematic arrangement of the principles on

which it is based. It is objected that professional education should be rather in the science than in the art, rather in the underlying and unchanging principles upon which the art reposes, than in the technique of the art itself. Principles, it is urged, are to be explained in words and thoughts, rather than in laboratory manipulations; they are to be imparted, then, by thought, by reasoning, by lectures and text-books, rather than by doing things with the fingers. The laboratory, it is urged, is no place to teach principles.

Second, the actual conditions of metallurgical practice on a commercial scale, that is to say, the conditions of the art as it will have to be practised, cannot be reproduced in any laboratory.

Let us examine these two objections.

The contention that education should be in principles rather than in the technique of practice, in the science rather than in the art, no educator worthy of the name can question. But this granted, the question remains how best to teach principles. To teach them effectively seems almost necessarily to require some conception of the things to which they relate; certainly, such conceptions must very greatly facilitate teaching. If the subject is of such a nature that sufficient conceptions concerning it have been formed during the student's prior life, then laboratory practice is less important, or even superfluous; if not, if such conceptions are lacking or defective, then laboratory practice may be a most ready way of supplying or strengthening them.

Of the conditions attending metallurgy the student certainly has acquired no sufficient conceptions during his prior experience: his want here is more serious than in case of chemistry and physics, and because it is more serious, because these conceptions while hard to supply verbally, are readily supplied by laboratory practice, the metallurgical laboratory seems to me of the greatest value as a preparation to the study of the principles of this art.

Let us test this reasoning, this assertion that conceptions if not a prerequisite, are at least an invaluable aid to the study of principles, of general laws. Surely to grasp the principles of legislation there should be a conception of human nature; to understand the laws of music and painting there must be a conception of sound and color. Is not the same true then, of chemistry and metallurgy, that in order to understand their laws the student should have a conception of the conditions and of the kinds of phenomena with which those laws deal?

The objection which at once arises is that, in case of mathematics, no

laboratory work is needed; that in case even of music and painting, exercise in the art itself is certainly not necessary to enjoyment of its products and probably not necessary to a clear comprehension of its principles. Why then in chemistry and metallurgy? The answer is, that the conceptions underlying mathematics, music and painting have already been acquired spontaneously, have become part of our very nature; and that in case congenital blindness or deafness has forcibly prevented the acquisition of these conceptions of color or sound, it has thereby made the study of the principles of painting or of music impossible.

Let us look at this a little more closely.

That every youth has acquired spontaneously and inevitably the conceptions underlying mathematics, the conceptions of number, distance, direction, and force seems clear.

The child deprived of every sense save touch, begins with its first breath to familiarize itself with these conceptions. The resistance offered by fixed objects, the mobility of movable ones, the resistance which friction and inertia oppose to his moving them, the fact that he cannot move the bedpost, that he can move his hand with ease, and his heaviest toy with difficulty, from the first give him the conception of force. The conception of two hands as distinguished from one is the conception of number, forced on him by every scene. Every glance of the eye, or if he is blind, every reaching out for toy or foot, gives the conceptions of distance and direction. These conceptions then are inevitable, they cannot be shut out by defects of the sense; hence the study of mathematics does not call for any special preparation comparable with the laboratory preparations for the study of chemistry and metallurgy.

So is it with music and painting to the child with all his senses.

The sighted youth comes to the study of painting with an eye trained from first infancy through sixteen hours of every day of his seventeen years in color perceptions, in the glories of the sunset, in the marvelous harmonies of the landscape, in the play of human expression, in the effects of shadow and perspective. He comes with conceptions so familiar and complete, so essential a part of his very being, that henceforth he cannot think shape without interjecting his conceptions of shade and color; he cannot conceive any object without conceiving it as colored or shaded.

To the study of the laws of music the youth with normal ear, the so-called ear for music, comes with the experience of seventeen years, those wax-like, plastic years, of the sensuous pleasure due to certain sounds

and sequences of sound and the annoyance which others cause, not only to himself, but to those about him. The mother's lullaby begins his acquaintance with pleasurable sound; his own shrieks, the clanging bell, the squeaking slate pencil early impress on him the disagreeable in sound. So complete and familiar are his sound conceptions that no special training in them is imperatively needed to enable him to begin the study of the science of music.

But let congenital blindness or deafness forcibly prevent him from acquiring these conceptions, and it thereby as forcibly and as absolutely unfits him for the study of the science of color or music. How can the congenitally blind, to whom red is as the blare of the trumpet, comprehend a discourse on chiaroscuro? Or with what profit can you explain to them the proper tint of shadows while all conception of both tint and shadow is not simply vague, imperfect rudimentary, but absent? Or how can the congenitally deaf understand the very terms harmony, discord, major and minor? Before they can conceive what minor means, must they not have some conception of sound?

Even after the missing sense has been given to one thus congenitally defective, to acquire the missing conceptions is a work of time. Open blind eyes at seventeen and all is seen in confusion ; time and acquaintance must make conceptions clear and familiar, conceptions and interpretations of shade and perspective, before the science of painting becomes comprehensible. Unstop deaf ears at seventeen and not only is a symphony of Beethoven absolutely meaningless, but all sound fails to be interpreted. Only after time has supplied the familiarity with sound conceptions which childhood should have given, only then can the study of the principles of music be begun.

These cases thus support the contention that familiarity with conceptions and conditions, if not absolutely necessary to the study of principles, is at least an invaluable, an incalculable aid.

The student beginning the study of metallurgy has something in common with one who should begin the study of the science of music immediately after the instantaneous cure of congenital deafness. As it is hard for us to grasp our own infantile difficulties in interpreting the sensations on our retinas, so one who begins to teach metallurgy late enough in life to have lost sight of the mental condition of his student days, is at first puzzled by the density of his pupils' ignorance. They lack the very beginning of those every-day conceptions so familiar to the

teacher himself. To a man from the moon the conception that water runs down rather than up hill would be novel.

Without conceptions of metallurgical conditions and surroundings, your reasoning about metallurgical processes may wring an acquiescence from the student's intellect, but all remains unreal, unheld by the memory, unimpressed, like a pale algebraic demonstration.

Now, I take it, that the great object of laboratory instruction is to supply lacking conceptions. Though the youth has seen chemical actions going on around him, his attention has not been sufficiently concentrated on their essential features. The chemical laboratory reinforces his deficient observation, clarifies his hazy conceptions of gasification, sublimation, precipitation, solution, fusion, liquefaction, solidification, freezing diffusion, the exact balancing of reaction, substitution, the indestructibility of matter. Beyond this it impresses on his memory the chief characteristics of the more important chemical substances by vivid picture and by personal acquaintance, instead of by mere description from the lips or pen of teacher. They become to him as his playmates in the flesh, instead of as the heroes of his story books. It is no just reproach to call this kindergarten work; calling names is poor argument. It does to the youth what the kindergarten does to the little child, directing observation into fruitful fields.

Why, now, have I said that laboratory instruction is even more pressing in case of metallurgy than in that of chemistry or of physics? Because the conditions, especially the high temperature conditions, which surround metallurgy are stronger, newer, less foreshadowed by childhood's prior experience, less readily evolved from our consciousness, less easily pictured by the words of lecture or text-book than those which attend chemistry and physics as these are chiefly taught, the chemistry and physics of the normal or every-day temperature, that little range between the freezing- and boiling-points of water. The conditions and phenomena even of common-temperature chemistry and physics indeed, are relatively unfamiliar to the beginner. This, however, is not so much because they and their likes have not been seen, as because attention has not been concentrated upon them. The pictures are already in the memory and respond readily to developing and fixing by skilful language. The daily ablutions teach the integration of soap and certain dirt and the insolubility of other dirt; sugar and salt at the breakfast table teach solution; the settling of fine mud in the brooklets and pools teaches decantation; the clearness of the spring exemplifies filtration;

the tea kettle and soda water teach ebullition; the drying roofs show evaporation; the sweating of the ice-pitcher illustrates the principle of the dewpoint; the sponge teaches surface-tension. All these and a hundred like images already exist in the memory and have but to be recalled to become vivid, but to be interpreted to serve as types of our chemical and physical phenomena.

But of metallurgical conditions the youth's past has given little foretaste. Especially is this true of the solvent fluxing action of that high temperature at which the rocks and most of the metals are as water; many other metals are gaseous, and strength and even solidity itself are to be found in only a very few substances. And even these react energetically on almost everything they can touch. In the crucible of the iron blast-furnace there is but one substance that remains solid which can offer support, and that is carbon, but this itself reacts on most things exposed to it and is in turn attacked and destroyed by them. This reciprocal destruction, this Kilkenny-cat attitude of nearly every available substance toward every other, is not only itself unlike anything the student has previously known, but it results in a difficulty previously unthought of, the baffling difficulty of devising any retaining vessel whatsoever. The solids we children have known stay put; the liquids rest peacefully in the familiar tin can, or in the few cases in which they may not be used, then in vessels of wood, glass, porcelain, or clay indiscriminately.

Indeed, the fiery magmas with which metallurgy has to do, the molten metal, the molten slag and molten matte, are in themselves and apart from their corrosive nature, substances unlike anything in the notice of our early years, which has been directed chiefly to solids and aqueous liquids. The nearest approach to acquaintance is the hazy conception of lava streams of which we have read. Still more remote from our experience are the reactions between these plutonic bodies which play so large a part in metallurgy, the purifying action of slag on metal, the slag's retentivity of metal or of metalloid according to whether it be acid or basic, the coalescing of the oxides and acids into one magma, the slag; of the sulphides into a second, matte; of unoxidized and unsulphuretted elements, both metals and metalloids into a third magma, the metal; and the reciprocal expulsion which each magma exerts toward the other. Here, indeed, we have a class of bodies and of reactions so unlike those of which the usual chemical laboratory instruction treats, that metallurgical laboratory practice should be added to chemical.

To supply clear conceptions of these strange metallurgical conditions

and thus to build a foundation for thought and reasoning, is, I believe, the chief work,—the invaluable work of the metallurgical laboratory.

To build this foundation well, the student should, I think, perform a great variety of simple experiments, each of which should direct his attention to a very few, or even to one important principle and avoid diverting it to attendant administrative details. For instance, his furnaces should in general be heated by gas or electric resistance, so that his attention may be concentrated on the phenomenon which he is studying, and not diverted to keeping a coal fire in proper condition.

If I am right in saying that the laboratory is thus an invaluable instrument for preparing the student for the studying of principles, the first of the two objections urged against metallurgical laboratories, that education should be in principles rather than in practice, falls to the ground.

The second objection, that the conditions of actual practice cannot be reproduced in the laboratory would be unworthy of notice, were it not offered by men of such weight that even their errors must be considered.

The error lies in supposing that this instruction aims to anticipate practice in commercial establishments, whereas its aim is to facilitate instruction in metallurgical principles by lectures and text-books. There is no more reason for reproducing commercial practice exactly in the metallurgical laboratory than for reproducing in the chemical laboratory the system of kilns, towers and leaden chambers of the sulphuric acid works. But even from this mistaken point of view the objection is without weight. With equal force it can be urged that fire drill and military drill are useless, because they cannot reproduce exactly the actual conflagration, and the actual carnage and confusion of battle.

Another and important work of the metallurgical laboratory is to give a certain skill in the use of instruments of precision of the art, in pyrometry, calorimetry and the microscopy of metals and alloys. It seems to me nearly as imperative that the metallurgist's diploma to-day should imply this skill as that the civil engineer's should imply skill in the use of the transit.

Finally, just as into a barrel full of potatoes a quarter of a barrel of sand can be poured, and then a quarter of a barrel of water, so after the student's power of study and note-taking in lectures has been thoroughly utilized, he still has power for much of this different, this observational and administrative laboratory work, in which he absorbs and assimilates priceless information like a sponge, and acquires along the path of least

resistance and with but little mental effort, the needed metallurgical conceptions.

At the close of the exercises, a procession was formed under the direction of Professor W. B. Owen, who acted as marshal, and the company proceeded to the entrance of the new building, where the building was formally transferred by Mr. Gayley to Dr. Warfield, who, in the absence of Mr. John W. Hollenback, President of the Board of Trustees, received it.

Mr. Gayley's Address.

To make complete this building for the use of the college it only remains for me to formally transfer it to you, as representing the Board of Trustees. But, before doing so, I want to take this opportunity to acknowledge the great service that has been rendered to me and to the college by Prof. Hart, upon whom fell the whole burden of supervising the construction. How well he has developed and worked out the scheme will soon be appreciated by those who will pursue the courses to be taught here.

I am particularly pleased that the interior construction is on lines so severely practical that it becomes a constant object lesson alike to the teachers and students in these departments. And from this I argue that the instruction in chemistry and metallurgy shall also follow along the same practical lines.

As this is the age of industry, it is my great desire that the instruction given in this building shall so instil the spirit of industrialism, that it may cause men with the strongest brains and ambitions to direct their energies toward industrial advancement. And I rest content in the belief that there shall come from this institution, some men, who have profited by the instruction they have received in this building, and who shall mark progress in some of our nation's great industries. And by this token [the keys] I herewith transfer through you to the college, all right and title to this building, to be used as the trustees may deem for its best interests.

After brief remarks by Dr. Warfield, accepting the gift, Reverend Samuel A. Gayley, D.D., of the Class of 1847, the father of James Gayley, made the dedicatory prayer and pronounced the benediction.